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(54) INK-JET PRINTING HEAD AND METHOD OF MAKING IT.

(57) An ink-jet printing head (1) has a chamber (2) for colour liquid and a unit (3) for applying the liquid to a carrier (4). The unit (3) is provided with through openings (6) connected to the chamber (2) and consists of a multilayer structure some layers of which form electrodes (7,8) and current-feeding contacts as well as a magnetic layer (12). At the moment of applying a voltage pulse to the electrodes (7 and 8) an electrodynamic force is generated ejecting a liquid drop from the opening (8). A method of making the printing head is also proposed.

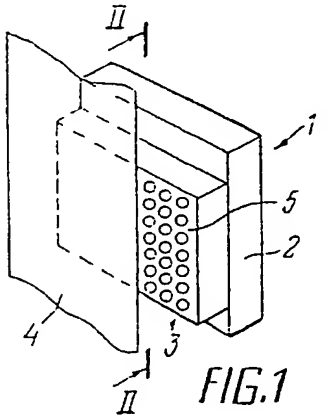

FIG.1

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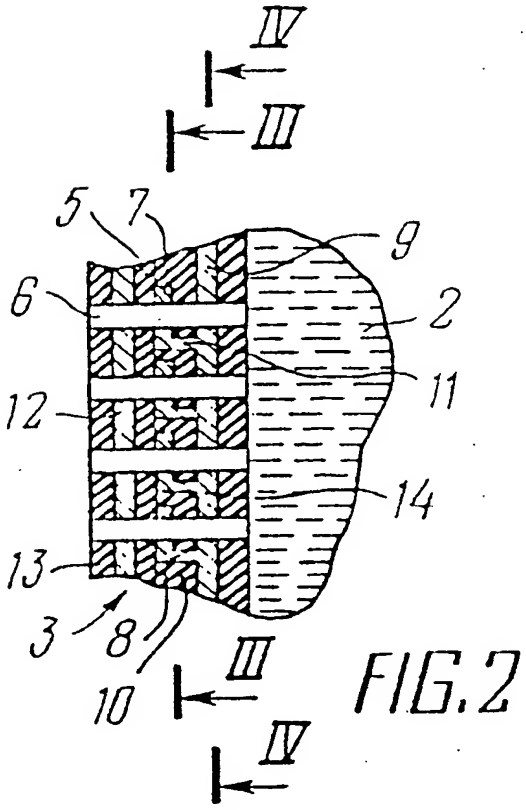

FIG.2

A JET PRINTING HEAD AND A MANUFACTURING METHOD THEREFOR

Technical Field

The present invention relates to printing devices and in particular to a jet printing head and a manufacturing method therefor.

Background Art

A known jet printing head comprises a chamber suited to hold an inking liquid, one of its walls having nozzles uniformly disposed in rows and representing capillary holes. Each nozzle has a pair of electrodes separated by an insulating rod whose conical end faces the nozzle. The nozzle also has a conical inlet and a cylindrical outlet connected therewith. As pulse voltage is applied to the electrodes, the liquid in the respective nozzles is instantaneously heated whereby a maximum pressure characteristic of pin-point microexplosions is produced at the cylindrical outlet of the nozzle. The inking liquid is discharged from the nozzle onto a data medium to make a corresponding record (cf. SU, A, 1100142).

One of the disadvantages of such a structure is associated with unwanted complexities involved in production of a nozzle having conical and cylindrical sections which should be made to a high accuracy because even a slight deviation from preset parameters impairs geometry of a drop of inking liquid coming out of the nozzle, a factor adversely affecting printing quality. Likewise the insulating rods should meet stringent requirements for accuracy in production and installation. This calls for the use of precision equipment and skilled labour, which substantially increases the cost of such a printing facility. Furthermore, frequent drastic temperature changes in the liquid cause wear of the electrodes and the rod. Also, the liquid should be often changed due to its disintegration in heating.

There is further known a printing head with an electric means for supplying a conducting liquid dye staff to a data medium, which comprises an inking chamber with an assembly suited to supply said liquid dye staff and having a plurality of tubes of a sufficiently large diameter, said tubes being essentially capillary nozzles. The known printing head comprises a multitude of pairs of electrodes, each of which is fitted on diametrically opposite sides of the tubes at right angles to the tube axis, as well as a permanent C-magnet encompassing the head so that the magnetic field of the magnet passes through all the holes (cf. Us, p, 4023180). On application of a voltage pulse to a pair of electrodes, they will pass current due to electric conduction of the liquid. As said current interacts with the field of the permanent magnet, there is produced an electrodynamic force ejecting a drop of inking liquid from the given capillary tube. Although a fairly small current passed through the electrodes does not cause their failure and disintegration of the inking liquid, the construction of the disclosed printing head is rather complicated due to the need for inserting the electrodes in the capillary tubes and aligning them in a precise manner relative to the tube axis. If the alignment is not exact, printing quality is drastically impaired. Moreover, it is practically impossible to connect the electrodes securely to current buses. Finally, a reliable discharge of drops of inking liquid from the head nozzles necessitates similar conditions for each capillary tube, that is, a similar magnetic field in the zone where the electrodes are positioned and similar strength of a current pulse flowing therethrough. In the case of a C-magnet the magnetic field in the centre is much weaker than that round the periphery, a factor substantially affecting printing quality due to impaired formation of drops of liquid discharged from the capillary tubes. Furthermore, the size of the C-magnet must exceed by many times the area occupied by the capillary tubes to obtain an essentially uniform field over the entire area of the printing head.

Disclosure of the Invention

The object of the invention is to create a liquid supply assembly of a jet printing head, in which a relatively simple novel design would ensure similar magnetic intensity for each capillary tube in passing current pulses through electrodes thereof.

There is provided a jet printing head comprising a chamber holding a conducting liquid dye staff and an assembly suited to supply said liquid to a data medium and having rows of capillary nozzles and electrodes, in which, according to the invention, each row of nozzles has a common electrode of one polarity, while each nozzle in this group has an individual electrode of opposite polarity, all the electrodes being disposed in one plane at right angles to the nozzle axis. Said supply assembly is also provided with current buses of the individual electrodes, which are arranged in a plane parallel to the electrode plane, separated therefrom by a dielectric layer, oriented along lines crossing with the lines interconnecting the electrodes of each group at an angle of 90° and jointed to the individual electrodes of the respective groups. A perma-

nent magnet of such a group represents a magnetic layer arranged in a plane parallel to the plane containing said groups of the electrodes on the opposite side of the inking liquid.

Such a structure of the proposed printing head has a number of advantages, for example, simpler design due to a smaller number of current leads (one bus for a row of nozzles) and better printing quality owing to more reliable ejection of drops from the nozzles, which is attributable to uniform intensity of the field set up by the magnetic layer. Furthermore, the printing head according to the invention allows manufacturing a supply assembly with a practically unlimited number of nozzles.

The proposed printing head is manufactured by forming a laminated structure with conducting and insulating layers arranged in rows and constituting electrodes and buses, and by subsequently cutting through capillary holes.

Brief Description of the Drawings

The invention will now be described further with reference to a specific embodiment thereof, taken in conjunction with the accompanying drawings:

FIG. 1 is a general view of a jet printing head according to the invention;

FIG. 2 is section II-II of FIG. 1;

FIG. 3 is section III-III of FIG. 2; and

FIG. 4 is section IV-IV of FIG. 2.

Best Mode of Carrying out the Invention

Referring to FIG. 1 the proposed printing head designated as a whole with reference numeral 1 comprises a chamber 2 filled with a conducting liquid dye staff and an assembly 3 suited to supply the inking liquid to a data medium 4.

The assembly 3 (FIG. 2) suited to supply the inking liquid is a multilayer structure formed on a base 5 and having through holes 6 which are in communication with the chamber 2. The holes 6 are disposed in rows along parallel lines, their axes bring perpendicular to the surface of the inking liquid. Each row of said holes has an electrode 7 common to all the holes in the given row, the total number of such common electrodes being equal to the number of rows of the holes 6. Said electrodes are made as buses arranged on the inner side of the base 5 facing the chamber 2. Moreover, each hole in said rows is provided with an individual electrode 8. The electrodes 8 are arranged in the same plane as the electrodes 7 at right angles to the axis containing the capillary holes 6 but on the diametrically opposite side of the holes in one row. Thus, all the electrodes are located on one side of the base 5 in the plane perpendicular to the hole axis and form one layer of the multilayer structure. The electrodes arranged in different rows are electrically insulated from one another. The individual electrodes 8 have current buses 9 located in a plane parallel to the plane containing the electrodes 8 and separated from said electrodes by a dielectric layer 10. The buses 9 are oriented along lines perpendicular to the electrodes 7, each bus being connected only with one individual electrode in different rows of said holes.

So, as follows from FIGS 3 and 4, the electrodes 7 and the buses of the electrodes 8 are arranged along mutually perpendicular crossing lines and separated by the dielectric layer 10.

Jumpers 11 for connecting the individual electrodes 8 to the buses 9 pass through the dielectric layer 10 parallel to the axes of the holes 6.

Arranged on the outer side of the base 5 opposite to the chamber 2 is a magnetic layer 12 protected with a film 13. An insulating layer 14 protects the multilayer structure on the opposite side.

The jet printing head according to the invention operates as follows.

As a voltage pulse is applied to one of the buses 7 and to one of the buses 9, the electrode circuit of the corresponding capillary hole 6 related to the given electrodes is closed. Current flowing through said circuitinteracts with the magnetic field set up by the magnetic layer 12, due to which there is produced an electrodynamic force ejecting a drop of ink from the respective capillary hole 6, which is directed to the data medium 4.

The described jet printing head is manufactured as follows.

Applied to the base 5 of a suitable dielectric material on one side by any known techniques are parallel rows of continuous strips of a conducting material forming the electrodes 7 and discontinuous strips 8 forming individual electrodes, the distance between the applied continuous and discontinuous strips being somewhat smaller than the diameter of capillary holes.

The obtained one layer of the multilayer structure is topped with the insulating layer 10 to which the conducting layer 9 is applied, the latter layer representing continuous strips perpendicular to the strips forming the electrodes 7. Thereafter conducting jumpers are formed between the electrodes 8 and the strips of the layers 9. The formed structure is coated with the insulating layer 14. Next, on the opposite side of the base 5 there is formed the magnetic layer 12 topped with the protective film layer 13. Any known techniques will then be used to cut rows of holes in the obtained multilayer structure in the areas around the electrodes 7 and

the individual electrodes 8, said holes passing partially through said electrodes. Then the supply assembly is joined to the chamber 2.

Industrial Applicability

The jet printing head according to the invention allows contactless application of data to different media such as paper, film and the like. Thus, the invention can be used in printing arts and data-providing equipment for manufacturing alphanumeric printers.

Claims

1. A jet printing head comprising a chamber (2) adapted to hold a conducting inking liquid and having an assembly (3) suited to supply said liquid to a data medium (4) and provided with capillary nozzles (6) communicating with the chamber (2) and disposed in rows along parallel lines, as well as electrodes (7, 8) with current buses, and a permanent magnet (12), **characterized** in that each row of the holes (6) has one common electrode (7) of one polarity, while each nozzle (6) has an individual electrode (8) of opposite polarity, all the electrodes being located in one plane perpendicular to the axis of the holes (6), the supply assembly (3) being provided with current buses (9) of the individual electrodes (8) disposed in a plane parallel to the electrode plane, separated from said electrodes by a dielectric layer (10), oriented along lines perpendicular to the electrodes (7) in each row and connected to the individual electrodes (8) of the corresponding groups, and the permanent magnet (12) is a magnetic layer arranged in a plane parallel to the electrode plane on the opposite side of the inking liquid.

2. A jet printing head as claimed in Claim 1, **characterized** in that the current buses (8) are connected to the individual electrodes by means of jumpers (11) passing through the dielectric layer (10) parallel to the axes of the capillary nozzles.

3. A jet printing head as claimed in Claims 1 and 2, **characterized** in that the magnetic layer is coated with a protective film (13).

4. A method of manufacturing a jet printing head as claimed in Claim 1, **characterized** in that it comprises the steps of forming on a base in one plane continuous and discontinuous strips placed in parallel to each other, forming a dielectric layer, applying to said dielectric layer continuous strips disposed at right angles to said continuous strips on the base with a view to forming current buses of individual electrodes, connecting the continuous strips serving as the buses of the individual electrodes by means of jumpers to the corresponding one individual electrode in each row, applying on the opposite side of the base a continuous layer of magnetic material uniformly covering the entire base, applying a protective layer to the magnetic layer and a dielectric layer to the continuous strips forming the buses of the individual electrodes, and forming through capillary holes in the multi-layer structure in the areas where the continuous and discontinuous strips are located so that said strips are partially cut.

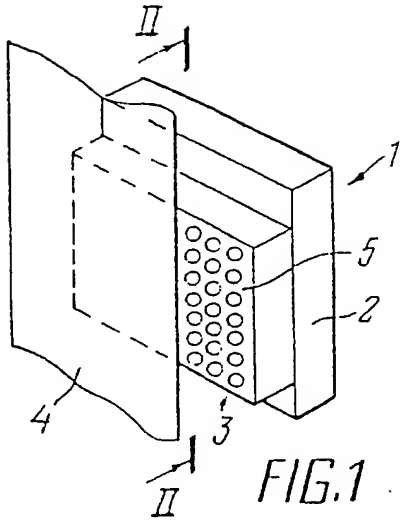

FIG.1

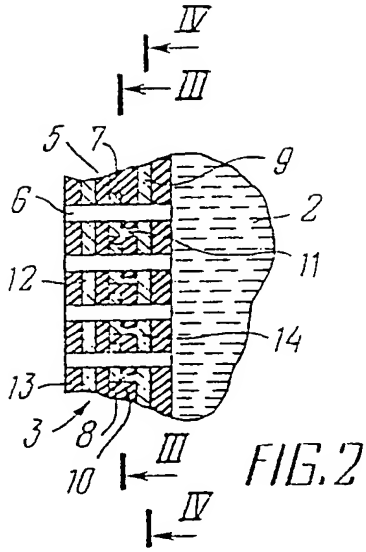

FIG.2

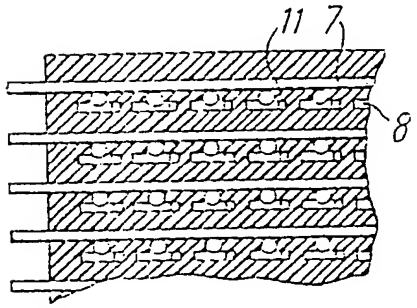

FIG.3

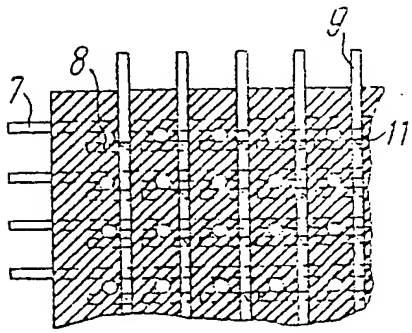

FIG.4

INTERNATIONAL SEARCH REPORT

International Application No PCT/SU 89/00208

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) *

According to International Patent Classification (IPC) or to both National Classification and IPC

Int.Cl.[5] B 41 J 2/07

II. FIELDS SEARCHED

Minimum Documentation Searched *

Classification System	Classification Symbols
Int.Cl.[5]	B 41 J 3/02, 3/04, G 01 D 15/18

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched *

III. DOCUMENTS CONSIDERED TO BE RELEVANT *

Category *	Citation of Document, [11] with indication, where appropriate, of the relevant passages [12]	Relevant to Claim No. [13]
A	US, A, 4280130 (ARTHUR J. SLEMMONS), 21 July 1981 (21.07.81), see the abstract, the claims	1-4
A	US, A, 4354197 (NCR CORPORATION), 12 October 1982 (12.10.82), see the abstract, the claims & WO,A1, 8201246, 15.04.82 EP,A1, 60881, 29.09.82 CA,A1, 1172685, 14.08.84	1-4
A	US,A, 4023180 (WALTER J. ZENNER), 10 May 1977 (10.05.77), see the abstract, the claims	1,2,4
A	US,A, 4463676 (HITACHI, LTD), 7 August 1984 (07.08.84). see the abstract, the claims 2,3 & JP, A,58033480,26.02.83	1,3,4

* Special categories of cited documents: [10]

"A" document defining the general state of the art which is not considered to be of particular relevance

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"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
25 January 1990 (25.01.90)	27 February 1990 (27.02.90)
International Searching Authority	Signature of Authorized Officer
ISA/SU	

Form PCT/ISA/210 (second sheet) (January 1985)